



# Barriers on the propagation of household solid waste recycling practices in developing countries: State of Palestine example

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## Abstract

Recycling is one of the management options applied to: minimize the landfilled waste quantity, provide raw materials, and assist in sustaining the environment for future generations. The success of any recycling program globally depends mostly on the active and sustained participation of citizens. The purpose of the conducted research presented in this paper is to investigate the recycling barriers and offer an insight into the motivations that may encourage local population to increase participation in local recycling schemes. The research focused on Ramallah and Al-Bireh district of Palestine, which is a developing country with minimum infrastructure and economics; the raw data were collected using structured questionnaires. The influence of four basic socio-economic factors, namely, gender, level of education, age, and type of residence, on recycling barriers of individuals was recorded and investigated. The results showed that: lack of awareness and information on the process of waste separation and storage are the basic recycling barriers of the local population, whereas financial incentive is the major motivational factor for their active participation. Most importantly, the field research proved that locals are willing to participate in recycling campaigns and almost half of them appreciate the necessity of recycling-green-point's existence for the collection of segregated waste.

**Keywords** Household solid waste · Attitudes · Public participation · Socio-economic factors · Ramallah and Al-Bireh district

## Introduction

Increase of economic growth results in unavoidable increase of solid waste causing serious problems related to human health and the environment [1, 2]. Increased solid waste quantity [3] is one of the problems which besides other cause lack of landfill space leading into many problems, e.g., exhaustion of existing landfill sites, difficulty in obtaining new disposal sites and preservation of open dumps.

Many alternatives are suggested as management options to decrease waste quantity and hazard level [4], such as

segregation and recycling, segregation and composting of organic waste, and incineration. All the proposed technologies are included as solutions in strategies' design in most countries [5]. Recycling is defined as “the series of activities by which materials that are no longer useful to the generator are collected, sorted, processed, and converted into raw materials and used in the production of new products” by EPA [6], where the household recycling benefits are justified by four main points:

- Less waste is disposed, lowering down the need for land filling and incineration.
- Energy saving.
- Sustain the environment for future generations.
- Reduction of the demand for virgin raw materials.

Successful recycling strategies globally involve besides the careful planning of the recycling scheme, wide sensitization campaigns to encourage the public to cooperate and actively participate [1, 7, 8]. Increasing public participation in household solid waste recycling cannot be achieved unless

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all reasons for not recycling are cleared out. Therefore, knowing that the reasons is the key for increasing recycling rates in many countries [9].

Available international scientific literature presents a significant amount of factors influencing the participation in organized recycling schemes. The conduction of field researches provides local stakeholders with the necessary information; consideration of a variety of reasons and motivations encourages the government and other authorities to adopt and develop recycling practices [10] or alters them to improve their outcomes (e.g., recyclables quantity and quality).

Bernstad et al. [11] state that the application of waste source separation programmes can contribute into 80% diversion of waste and reducing the potential impacts on the environment. It is crucial to implement successful recycling activities. To do so, it is important to develop solid waste management policies nationally, regionally, and locally by the corresponding authorities that set the base of the implementation of any waste management program. The development of strategies will be followed by national policies which will set the appropriate targets in terms of, e.g., recycling level, recycling scheme performance, etc. [12]. The whole process requires the citizens' participation and reaches to high efficiency levels once the appropriate supporting infrastructure is provided [13–15]. Recycling is not an isolated action; besides the active and sustained contribution by the citizens, the appropriate segregation and collection of recyclable waste is a significant parameter as well [16]. In addition, to that existing market for recyclables constitutes a significant parameter; therefore, public attitudes towards environment-friendly products purchases (made from recycled materials) are also an essential factor. It all comes back to individuals' participation, so there is a real need to educate citizens on the negative impacts on environment, health, and economic caused by the improper waste disposal, and on the available initiatives, they can take up, e.g., solid waste recycling [13].

Overall, field researches conducted worldwide, present a variety of recycling barriers faced by the citizens' well as the motivation factors. Developed and developing countries present some similar recycling barriers; the significant differences in the technological and financial background among them have, therefore, specific recycling barriers to prevail over others. To this direction, the local economic situation should be taken into consideration: this field was investigated prior to the research implementation in the target areas of the present paper.

Palestine's gross domestic product (GDP) growth rate is 4% that is considered medium for a developing country. The economy is extremely fragile thus undertaken measures regarding all aspects (waste management included) should be carefully planned and tailored solutions should

be applied. This paper presents the identified recycling barriers as identified by a field research in a territory of Palestine, and compares them with findings from other researches' conducted in both developed and developing countries. This sort of information is useful for parties (governmental, regional, and local authorities) that plan and execute solid waste management plans, to take effective measures for promoting recycling. The importance of the study also lies into the fact that in regions such as Palestine (and other similar developing areas with war-related conflicts/post recovery periods), the studies are difficult to be conducted, and that is why, they are rare. Regardless, their applicability to similar regional conditions is significant and their added value is that they offer a benchmark for future researches in DCs leading into important waste management decision making and best practices recording.

## Waste management in Palestine

The overall municipal solid waste generation is 1.423 million tone/year with a generation rate of 0.85–1.2 kg/capita/day in urban areas and 0.5–0.7 kg/capita/day in rural areas (wet volume basis) [17]. Household waste constitutes 56% of the total municipal solid waste and the composition of it (volume basis) is organic waste 55–70%, paper 12–17%, plastic 8–12%, glass 2–5%, and metal 2–5%. The indicated ranges on each waste composition are due to the presence of different types of localities (municipalities, villages, and refugee camps) with different socio-economic factors such as culture, level of economic development, geographic location, environmental condition, and energy sources. MSW in Palestinian high-income communities has paper, plastics, and other inorganic materials sharing the highest proportion, whereas low-income communities have the highest proportion of organic waste. Waste management involves disposal in landfills or in open dumps; 31% and 69% (that is approximately 0.441 million tone/year), respectively [17]. There is evident in the absence of the concept of waste minimization at source, recycling, and composting, since Palestinian experience in this field is still limited.

The Palestinian Environmental Law no. 7, approved in 1999, outlines the rules and regulations related to a wide scope of environmental issues related to solid waste:

- Article (7): the ministry has to set up a comprehensive plan for the solid waste management on the national level, leaving the responsibilities for the implementation of solid waste management operational services to the local authorities.
- Article (8): the different specialized agencies have the right to take the proper requirements to minimize solid waste generation and encourage solid waste reuse and recycling.

The existent law urges citizens to recycle, but a sustainable recycling system is not appropriately organized. Requests from international law adoption and citizens' urge the need to regulate this sector; to develop recycling scheme(s), to create the appropriate infrastructures, and to conduct a wide recycling campaign to achieve primarily rise of environmental awareness followed by increased participation in recycling.

In 2000, the Palestinian Environmental Strategies (PESs) were issued, where waste management was recognized as one of the most urgent environmental priority element that needs to be addressed to resolve the pressing environmental problems. In 2010, the last "National strategy for Solid Waste Management in the Palestinian Territory 2010–2014" was issued, emphasizing on recycling organic waste and encouraging the reduction of solid waste quantities destined to landfilling through practical models.

Environmentally aware Palestinian families who are properly organized in the frame of pilot programmes in their community and some institutions (academic, business, etc.) who are aiming to obtain the ISO-14001 (Environmental management) certification, practice waste segregation at source [17]. Primal recycling processes are performed informally in Palestine. At dumpsites, transfer stations, and near street refuse bins, waste picking, or scavenging activities are common scenes as in all DC. The existence of waste pickers/scavengers often creates an obstacle to the operation of solid waste collection and disposal services. However, if organized properly, their activities can be effectively incorporated into a waste recycling system, improve its efficiency, and cut down costs. Such an opportunistic approach is required for sustainable development of SWM programmes in DCs.

In the area of interest (research area: Ramallah and Al-Bireh district) according to the Joint Service Council for Solid Waste Management, the generation is 320 t/day on average. Waste composition is estimated at 56% organics, 30% inorganic (glass, metals, other not else classified), and 14% fines and miscellaneous wastes. Throughout the district, waste is collected from community containers and disposed of in uncontrolled landfills/ open dumps. Recycling remains at minimal rate in the district and constitutes less than 1% of the waste generated [18]. There are no official recycling programs in Ramallah and Al-Bireh district; a private company has contracts with several municipalities, commercial companies, and institutions (e.g., universities) for the collection of segregated paper and cardboard. Then, the recyclables are routed to Israel, where they are sold to another private company as a raw material. Recycling processes are not widely promoted to the citizens; only some NGOs conduct awareness campaigns about recycling and compost and practice in a limited scale, e.g., schools, parents association, certain citizens' groups, etc.

## The study area

The conducted research focused on Ramallah and Al-Bireh district (Fig. 1) which is one of the 16 districts in West Bank and Gaza strip it consists of Ramallah city, Al-Bireh city, and many surrounding towns, villages and refugee camps. Ramallah and Al-Bireh district is 16 km north of Jerusalem, with total area: 855 square kilometers represents 14.2% of the total West Bank area [19]. The population of the district in 2016 is estimated by Palestinian Central Bureau of Statistics (PCBS) of statistics to be 357,968 [19].

Among others, a significant research objective was to assess the origin of the low participation in recycling in Ramallah and Al-Bireh district, investigate the reasons for its occurrence, and gain an insight into the motivation parameters that may encourage the population towards household segregation and recycling practicing.

## Research methodology

Data collection was achieved through the development of a structured questionnaire that was divided into three sections. The respondents represented their households (they were the household heads responsible for waste separation) and were requested to provide the information hereafter described.

Primarily, the provision of the four specific socio-economic characteristics (namely: gender, education level, age, and residence type) presented the opportunity to the researchers to introduce four independent variables into the research and relate them with the recycling barriers or motivation factors.

The four aforementioned attributes have been long before introduced in the literature, since they play a significant role in waste management planning, organization, and actual implementation of schemes. The "gender" as socio-economic factor was involved in the research in the form of: participating men and woman quantity and female-to-male ratio. "Gender" is also connected to the "age" socio-economic factor. From literature review, it is clear that a gender and age structure of the population may have a significant impact on the waste generation. Such a dependence may occur due to differences in the way of life led by men and women and the habits associated with the consumption of products and waste management [20]. Furthermore, "age" is important for the extent of wastage, as young people waste much more than elderly do and consumers of high education, income, and living in urban areas are also reported to be responsible for more waste [21]. The later statement was the reason for the introduction of the socio-economic factors "education level" and "residence type" to the questionnaire preliminary questions (identifying the responder) and overall researches' raw data processing. The fourth socio-economic

**Fig. 1** Map of Palestine; Ramallah, and Al-Bireh district location is indicated in green color



factor (“residence type”) is strongly connected to the living status and cash flow, as monetary data are converted into physical, e.g., waste generated and disposed daily. It was chosen instead of the “annual income” to make participants feel comfortable (not embarrassed in case of very low income) and respond the research questions honestly.

Following the preliminary questions that mainly aimed for the satisfaction of the sample characteristics, participants were introduced into the main part of the investigation. A set of questions aimed at finding out their environmental management knowledge and their attitude towards recycling schemes (existing or future ones). Given that environmental awareness raising actions such as:

- spots regarding environmental sustainability are shown on local TV;
- leaflets are distributed to local population;
- courses are taught in elementary/high schools and universities;
- meetings are performed by local ecology-themed citizens groups;

Researchers wished to find out their impact to citizens and to identify their belief regarding them. Overall, to investigate the level of the actual in-depth understanding of the information provided and if local population exploits the existing local potentials.

Then, the questionnaire focused on the specific recycling barriers and the reasons for not implementing waste segregation in households were investigated. The determination of the appropriate parameters of a sustainable recycling programme was also investigated by requesting respondents to determine the parameters that could motivate and encourage them to participate to recycling activities. The questionnaire (which is in Arabic language) was pre-tested in other districts; several corrections took place, and then, it was distributed to locals who constituted the selected research sample of this research. The calculation of an adequate sample size is crucial in any study; thus, Creative Research Systems (<http://www.surveysystem.com>) survey software was applied as follows.

The calculation of the research sample size [22] was the outcome of the following two equations. The input data were the population of 357,968 capita (2016), the average family size of 5.1 cap/household, and the total number of households in Ramallah and Al-Bireh district of 70,189 [23]:

$$n = \left( \frac{z}{m} \right)^2 p(1 - p), \quad (1)$$

where  $Z$ : z-score (for this research it is 1.96 for 95% confidence level).  $m$ : margin of error (0.05 or  $\pm 5\%$ ).  $p$ : the estimated value for the proportion of a sample that will respond a given way to a survey question (0.80 for 80%).

In the science of statistics, the power ( $p$ ) is the probability of detecting an effect, given that the effect is really there. Likewise, the probability of rejecting the null hypothesis when it is in fact false. Researchers chose to apply an 80% power that means that if the study is performed 1000 times, a statistically significant difference 80% of the time would be noticed. This was selected to secure and validate the research outcomes, but mostly to represent reality rather than an optimistic interpretation of facts. Following that, the researchers used the Chi-square to compare the replies of categorical responses between four independent groups (age, gender residence, and educational level).

The sample size equation solving for  $n'$  (new sample size) when taking the Finite Population Correction (FPC) Factor into account is:

$$n' = \frac{n}{1 + \frac{n}{N}}, \quad (2)$$

where  $n$ : the sample size (based on the Eq. 1 outcome).  $N$ : households' population size (70,189 households)

Following this procedure, the questionnaire was distributed manually to over 400 householder owners from a wide spectrum of social status to achieve a representative sample. Where necessary in case of, e.g., elderly, disabled household owners face-to-face interviews took place.

Totally, 246 fully answered questionnaires were collected and fulfilled all research aspects. Those not fulfilling all set criteria were discarded as insufficient as well as those who included contradictory replies.

Given the 95% confidence level (Eq. 1) and the 6.2 confidence interval selected for this research, the amount of households investigated (246) offers safe results and conclusion for the total area, where the investigation took place.

Data were collected during March and April 2016. The waste generation and recycling trends have not changed particularly since then. Nevertheless, cross checks have been performed in the meantime regarding those two important elements. The confidence level of this research was carefully chosen to present credible outcomes and overcome the minor system changes identified.

All data were analyzed using Statistical Package for Social Science (SPSS); Version 20 for Windows software. The alpha level was set at 0.05 to determine statistical significance of the influence level between socio-economic variables and recycling barriers. Descriptive statistics with a number of tests were applied including Chi-square tests. The aforementioned analysis was preferred to the analysis of variance (ANOVA), since the latter methodology is designed to determine if two sets of data are significantly different from one another, while a Chi-squared test is used to find out if there is a relationship between the two sets of data.



## Results

### Sample statistics

According to the collected data, most of the respondents live in Ramallah city (58%) followed by 32% who live in villages and 10% of them who live in camps. The majority of the respondents are relatively young (20–40) and over half of the sample population has a significant level of education. The detailed information on the research sample is presented in Table 1.

### Local environmental management potentials exploited

Following that, respondents were asked about their knowledge of recycling solid waste. Half of the respondents stated that they had a certain level of knowledge about recycling processes. When asked about the source of their knowledge, the majority responded that they obtained it from sources such as lectures in schools/universities and TV programmes (39.8% and 39.2%, respectively). Regardless of their knowledge level, the vast majority of them stated that they are not participating in recycling processes (96%) in Ramallah and Al-Bireh district. The later proves that despite the communication actions performed locally, citizens are not inspired to separate the generated waste in source and dispose them in the marked as municipal or recycling local waste bins. Identification of the reasons for this cannot be attributed to the detachment, since environmental culture is known to cost lessly when transmitted intergenerationally, or via costly education [24]. Based on EU, environmental culture is “the total of learned behavior, attitudes, practices and knowledge that a society has with respect to maintaining or protecting its natural resources, the ecosystem and all other external conditions affecting human life” [25]. In many reported cases, strategic decisions regarding the protection of environment, e.g., adopt and implement environmental programs and standards, depend upon the national environmental culture [26, 27]. Most importantly, for low wealth levels as in Palestine, society is unable to free many resources for

environmental culture. Another important factor in Palestine and in all developing nations is that environmental culture can induce the relationship between economic development and environment, as defined in the Environmental Kuznets Curve hypothesis [24]. This means that Palestine and generally all poor countries are currently increasing their wealth by living off the environment. In addition, while they get richer, their economic growth may decouple from pollution. However, economies are more polluting when they become more industrialized, while their pollution may decrease again when their economy shifts or transits into a service economy [24]. At that point, cleaner technologies should be applied to eliminate this negative impact. It is a long and demanding path road for most developing countries who struggle to maintain their ecosystem by undertaking basic but essential at the same time measures. Towards that path, environmental culture and awareness of citizens’ introduce a strong foundation to support upcoming strategy undertaking. Organization of waste management locally constitutes in other words one of the sectors, whose development is largely required to protect the local fragile ecosystems, avoid further degradation to identify milestones and bottlenecks, promote sustainable, low-cost solutions, and ultimately boost all economic sectors to growth.

### Recycling barriers

As aforementioned, 96% of the sample population are not participating in existing recycling programs. The reasons for this are reflected and contribute to the identification of the specific recycling barriers which are later on analysed based on specific variables of the population.

Overall participants (96% of the sample) were asked to list the reasons for non-participation in local recycling schemes. They were not provided with a list of reasons to feel free to express their point of view. Many of the received replies matched; they were grouped and presented below under the spectrum of the socio-economic indexes. Table 2 shows the influence of the gender factor on recycling barriers, and Table 3 shows the influence of the age factor on recycling barriers.

**Table 1** Information on the population sample that participated in the research

Gender	Male	Female				
	163 (65.7%)	85 (34.3%)				
Type of residence	City	Village	Camp			
	144 (58.1%)	80 (32.3%)	24 (9.7%)			
Age	20–30 years	31–40 years	41–50 years	> 50 years		
	105 (42.3%)	80 (32.3%)	45 (18.1%)	18 (7.3%)		
Level of education	Not educated	Elementary	Preparatory	High school	Bachelorette	Post graduate
	9 (3.6%)	7 (2.8%)	19 (7.7%)	53 (21.4%)	139 (56%)	21 (8.5)

**Table 2** Influence of the gender factor on recycling barriers that arouse by field research

Recycling barrier	Answer	Percentage of respondent (%)	
		Male	Female
Lack of awareness on the process of separation and storage	Yes	91.3	98.8
	No	8.8	1.2
None knowledge on waste segregation processes	Yes	68.8	81.0
	No	31.3	19.0

( $p < 0.05$ )

Usually, 41–50 year respondents constitute those statistically more busy than other age groups. They have a set of occupational standards as well as family members to take care of. They avoid take part in field researches even if their impact in the case of WM is high, given that they belong to multi-membered households. On the contrary, age groups greater than 50 years are willing to spare time to fill researches' questionnaires. An additional reason is the level of environmental culture of the 41–50-year-old group respondents; their attention was not drawn into WM issues during their childhood and that they tend to be less careful to certain procedures required such as sources separation. Based on the research results, their majority does not think that source separation is a time-consuming procedure (72.1%), and neither have they thought that is an unpleasant procedure (61.4%). The establishment of environmental culture is required for this age group to get active and involved in source separation procedures and teach their family members (especially younger ones) to act similarly as well.

The 10 recycling barriers (or else “reasons for not participating in the local recycling system”) vary, but the predominant ones are the following:

- Lack of awareness on the process of separation and storage (93.9%).
- Lack of official recycling programs (92.9%).
- Lack of information on the process of separation and storage (91.8%).

**Table 3** Influence of age group factor on recycling barriers that arouse by field research

Recycling barrier	Answer	Percentage of respondent (%)			
		20–30 years	31–40 years	41–50 years	> 50 years
Time is not sufficient for the separation of waste	Yes	51.4	56.4	27.9	47.1
	No	48.6	43.6	72.1	52.9
Process of separation and storage is not enjoyable	Yes	59.6	62.8	38.6	35.3
	No	40.4	37.2	61.4	64.7

( $p < 0.05$ )

- Lack of municipal authorities' encouragement (86.1%).
- Limited available facilities in the municipality or nearby (76.6%).
- Limited capacity of existing facilities (75.0%).
- Lack of knowledge on waste segregation processes (73.0%).

Less significant were judged the following:

- Lack of personal time for the separation of waste (48.6%).
- Demanding process of separation and storage, requiring a lot of effort (43.6%).
- Recycling (segregation and storage) is not considered a necessary process (24.2%).

The most important part of the research and data analysis involved the investigation of the socio-economic factors (i.e., gender, age, education level, and type of residence) on the recycling barriers already discussed. The statistical Pearson's Chi-square test was used to determine which of the responses (i.e., the dependent groups) correlate with the socio-economic factors in concern.

### Influence of the gender factor on recycling barriers

To find out the effect of gender on recycling barriers, the Chi-square test was performed. The test revealed that two out of ten non-participation reasons (as declared by the research household sample also mentioned above) have a statistically significant relationship (i.e.,  $p < 0.05$ ) with the gender (as also shown in Table 1). Mostly (98.8%) women declare to have “Lack of awareness on the process of separation and storage” and (81.0%) “Lack of knowledge on waste segregation processes”. The latter is considered a counter-logical observation since in a traditional community of a developing country usually females, not males, are the ones responsible for household waste disposal. It is worth mentioning that the unique qualities of women can make them bearers of solutions towards achieving sustainability [28] in any WM or solid waste recycling project, and most women unfortunately do not have sufficient experience in this area. It is not a hidden fact that “organisations of women” are

globally involved when new strategies of project on WM are launched to aim to a higher Public participation.

As in many developing countries so is in Palestine, women are typically responsible for cooking and household waste separation to a large extent of their home caring responsibility [8, 29]. At household level, the cooperation of all family members to waste separation process success is required. Women can drastically influence all family members attitude towards the establishment of environmental culture. To succeed it, they need to be educated and offered feedback regarding the recycling/source separation practices updating their capacity and introducing sustainability to their homes.

Overall, gender and income have high impact in WM. Based on the study, the lower living standards (e.g., camp residences) lead into low involvement in source separation processes since women have to deal with living hood problems that constitute all the other processes a luxury they either not comprehend or think they cannot pull through. General education does not play an important role in cases if poor households but age group balance the formed situation as younger women seem to be more concerned on the required activities that protect environment (e.g., recycling) [30].

### Influence of age group factor on recycling barriers

The person Chi-square test also revealed that two out of the ten non-participation reasons (as declared by the research sample) have a significant relationship ( $p < 0.05$ ) with the age (as also shown in Table 2). Specifically, 51.4% of the age group 20–30 years and 56.4% of the age group 31–40 years answered that “they do not have sufficient time for the required separation of waste”, while 72.1% of the age group of 41–50 years strongly disagree on that. The second reason (i.e., “demanding process of separation and storage”) constitutes a barrier mostly for those aged 20–40 years (average above 60%). The aforementioned proves the lack of environmental awareness and the urgent need for a wide recycling

campaign to the most productive age group of Palestine (i.e., 20–40 years).

### Influence of educational level factor on recycling barriers

The Chi-square test results correlating the educational level to recycling barriers provided researchers with results regarding the respondents’ educational level (as results shown in Table 4); the “limited facilities available” constitutes recycling pointless and unworthy in local level. The motivation is certainly significantly low in this case. In addition, more than half of the medium educated participants declared “the process of separation and storages is demanding (requiring lots of effort)”, which they are not willing to undertake proving also the low level of environmental awareness.

The recycling barrier (75% of the population sample) is “limited capacity of existing facilities” is identified also in a study by Martin et al. [13]. The need for recycling green spots and their operation provides citizens with an increased level of environmental awareness as the present research found out which matches also with the outcome of similar studies [10, 27, 28]. According to Afroz et al. [9], in the case of recycling, people are more likely to recycle waste when fully understanding the proper way and the reasons to do it. Lack of awareness and information on the process of separation and storage plays a significant role in recycling process and that is proved to be a reason for the low recycling rate also in Ramallah and Al-Bireh district. The low level of encouragement and the insufficient recycling facilities contribute to the low recycling rates. Similarly, in Hobart (Tasmania, Australia) storage container, restrictions and lack of information on recycling services were identified by Parsons and Kriwoken [27] survey. In addition, Martin et al. [13] who conducted a study on social, cultural, and structural influences on household waste recycling in the Borough of Burnley, England found that householders are very willing to participate in recycling, but the local recycling services were too unreliable and processes extremely inconvenient.

**Table 4** Results on the influence of “educational level” factor on recycling barriers that arouse by field research

Recycling barrier	Answer	Percentage of respondent (%)					
		Not educated	Elementary	Preparatory	High school	Bachelorette	Post graduate
Facilities available by the municipality or parties are not enough	Yes	88.9	71.4	78.9	64.2	82.5	78.9
	No	11.1	28.6	21.1	35.8	17.5	21.1
Process of separation and storage is a waste of time	Yes	44.4	42.9	42.1	28.3	21.2	0.0
	No	55.6	57.1	57.9	71.7	78.8	100.0
Process of separation and storages requires a lot of efforts	Yes	33.3	28.6	63.2	50.9	43.4	15.8
	No	66.7	71.4	36.8	49.1	56.6	84.2

( $p < 0.05$ )



In this research findings, most of the participants regardless of their educational level replied that unavailability of facilities is a significant barrier. Overall respondents with higher education found to be more likely to participate in such activities compared to the illiterate based on a previous researchers' work [29], so focus was given to those whose educational level is higher than "High school". The limited availability of facilities is a fact in Palestine as ascertained by the "bachelorette" and "post graduate" level respondents. All the remaining educational level categories may have heard or discussed this fact, so their reply reflects reality. However, one cannot say for sure that if the facilities' availability was higher that they would be participating in sources separation procedures, as environmental awareness and procedures' knowledge lack (also shown in Table 2). The latter affects directly also the "preparatory" educational level respondents that indicate that the processes for source separation are complicated in Table 3. As depicted in Table 2, gender does not play an important role in the case of separation and storage procedures. On the other hand, residence type that directly affects the living standards and the ease to make a living is a significant factor. Once again, the development of an environmental culture through education and communication activities is evident. In Ramallah and Al-Bireh district, most of the population (96%) does not participate in the recycling and half of them declared that they have received limited information on recycling issues. The recycling barrier identified (namely, "the lack of information and awareness on recycling services") has also been identified in Parsons and Kriwoken [31] study in Australia. On the other side, in Minsk, Belarus, Miafodzyeva et al. [32], stated that strong awareness on separate collection of waste, implementation of recycling in their everyday life and increasing public knowledge to recycle are factors that enhance successful recycling. Knowledge of local solid waste facilities' operation and awareness on local solid waste problems both have an influence on people's willingness to recycle as shown in two studies [3, 33] in Porto Alegre and Thailand. Bortoleto et al. [34] also found that environmental education is required and the local authorities should have an enhanced role in citizens' information on local recycling facilities, potential recycling materials, motivating them to participate in the local recycling schemes.

Citizens' in all DCs must be aware that participation in WM projects such as recycling is not only a mean to protect human health and the environment but also provide them with business opportunities. This is an interactive field, where environmental education, SWM projects efficiency, SWM infrastructure, and job opportunities feed each other. Recycling activities develop the local environmental and SWM market and provide (self-) employment opportunities and opportunities for decent work in the broader SWM and resource field require comprehensive programmes for human

development, education, building at the same time productive capacity and improving local infrastructure [12, 35].

### Influence residence type factor on recycling barriers

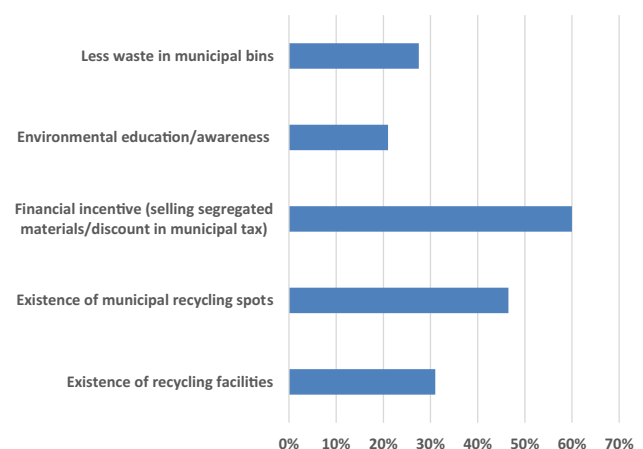
The residence type had significant relationship with only one of the reasons of non-participation; regardless of the residence type (City, Village and Camp) participants declare, since the "limited facilities availability" provided them with a reason not to recycle (82.1%, 71.3% and 62.5%, respectively).

### Motivational factors encouraging participation in recycling

The research concluded with a key issue for the implementation of a future sustainable recycling system in Palestine: the motivational factors. Participants were asked to indicate the 2 most important factors out of a list of 7 incentives listed that would encourage them to recycle and the allocation outcomes are shown in Fig. 2. The incentives list was formed according to the findings of an extensive international scientific literature [36, 37].

According to the participants, the greatest motivational factor which will encourage their participation in recycling is "the financial incentive" (60.5%), e.g., selling the segregated materials or having a discount in municipal taxes for waste management.

In addition, nearly, 47% of the respondents indicated "the implementation of recycling points" (specific places for the collection of segregated waste) as the second most important motivation factor. Finally, the existence of good facilities is considered an important motivational factor (31.9%) that encourages the respondents to recycle. They citizens expect recycling facilities in the near area that will handle most



**Fig. 2** Distribution of the motivational factors that encourage recycling as perceived by the research participants

of the collected recyclables and have economic benefits as well as positive impacts on the environment. Recycling will reduce the amount of overall waste disposed in municipal waste bins (~27%) and will lead into a lower number of waste bins required, leaving more space on the curbside according to their comments.

The key motive in recycling as pointed out the present and by other researches is “environmental education” [14]. Vicente [16] conducted a study on factors influencing household participation in recycling in Portugal and they found out that providing more and better information through direct and indirect media on recycling, clarifies the separate collection process, identifies all the materials that should be separated and the containers in which they should be deposited. The aforementioned promote recycling activities and contribute to a great propensity to participate in recycling when combined with information on recycling environmental and financial benefits. It is important to encourage citizens to participate in recycling and according to Parsons and Kriwoken [27] and play their role into the mitigation of environment damage, waste reduction, financial costs etc. as researches in Tasmania (Australia), Dhaka (Bangladesh) and northern Malaysia [9, 27, 38] indicated.

There are many motivational factors that can contribute to participating in recycling among people. The majority of respondents in this study have indicated that the main motivation factor is strongly connected to financial incentives, e.g., profit from selling recyclable materials or discount in municipal tax (60.5%). The same motivational factor was found in Afroz et al.'s [9] study in Bangladesh and Siwar [10] study in Malaysia that are also developing economies and share similar economic barriers as Palestine.

Belton et al. [39] pointed out that public attitudes towards green products (made from recycled materials) are very essential for recycling process. Respondents of the present research agreed (67%) to use green products, since it contributes to the enhancement of recycling in Ramallah and Al-Bireh district (expansion of recyclables market).

Targeted education is a way of bringing about public awareness on recycling practices in Ramallah and Al-Bireh district. Together with increased encouragement from the local authorities, it will contribute to the increase of recycling rates according to the 90% of respondents of this survey.

## Conclusions and recommendations

Recycling has been long viewed as a veritable tool in minimizing the amount of household solid waste that is disposed in landfills or in open dumpsites. It also provides with the required raw materials the local industries implementing the circular economy rules. It has been established that it

is among the most efficient and effective methods of solid waste management following the strategies of waste minimization and reuse according to EU waste hierarchy.

The idea of recycling is still new to the Palestinian society. There are some scattered activities, but it is still not a culture, nor a high-level investment; the Ministry of Local Government and the Environmental Quality Authority are aiming at spreading awareness and target the creation of strategic recycling practices.

Enhancing recycling is an important environmental action that should be taken into consideration in the enactment of future legislation and strategic planning at different decision-making levels within the Palestinian Territories. This research results facilitate tailored planning solutions to improve local waste management and in particular recycling across the socio-economic spectrum in Palestine highlighting the implications of false ‘standard-based’ planning. The findings and recommendations of the presented field research are certainly useful to the policy and decision makers of the appropriate authorities in their effort to improve solid waste management systems and promote recycling practices in Palestine as well as in any other developing country facing war-related conflicts/post recovery periods.

The collected data from 246 households in Ramallah and Al-Bireh district (Palestinian Territories) determined the recycling barriers and identified the influence of the four basic socio-economic factors (gender, age, education level, and type of residence) to them. The analysis of the local motivational factors, which will encourage locals to participate in recycling, provides differences and similarities to other researches in both developed and developing countries. Given that 96% of investigated population declared that they do not participate in local recycling schemes, the outcomes of this research provide responsible authorities with plenty of information to process and offer them a roadmap towards the implementation of recycling campaigns or the re-design of the local recycling scheme. The socio-economic factors and their influence on recycling programmes (outcomes of this research) are expected to assist decision makers. The definition of the appropriate target groups who are lacking either environmental education or environmental awareness and the appropriate communication of information by decision makers are what are primarily required to achieve higher recycling rates. For a successful recycling scheme, citizens’ participation and support is a prerequisite. The implementation of any recycling programme needs to face all involved barriers and replace them with strong incentives and motivation factors that encourage local population and increase participation rates.

After all the research proved that there is urgent need to change citizens’ underlying unwillingness to recycle. Addressing the environmental problems arising from waste management in Ramallah and Al-Bireh district will

indirectly improve the quality of waste management in the whole country through the demonstration of a success story. A mix of actions is required including legislation and policy revision, setting of new incentives, development of related infrastructure, environmental education, etc., to “shape” citizens to cooperate and adopt the waste recycling philosophy.

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